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ABSTRACT

Five structured components considered to be essential features of planning behavior are posited in this report. The cognitive issues of planning are assigned to the broader domain of representational thinking. Discussion then focuses on two of the planning components that involve a shift to metacognitive skills: (1) development of standards or criteria for reflecting on plans and their achievement or approximation; and (2) evaluation of the quality of the results of planning efforts. The emphasis of metacognitive components of planning differs from the strategy development and protocol analysis approach to planning that is taught in schools. Metacognitive aspects of planning enable consideration of the quality of performance, a consideration which is absent from developmental models of early cognition. This report advances a line of argumentation which illustrates that metacognitive processes and planning are closely related behaviors, and that planning and evaluation are collateral behaviors even in very young children. Findings of research on the language of preschool children at play revealed that they freely commented on the objects they used and chose. Examples of language used revealed the emergence of evaluating processes, possession of standards, thoughtful choosing, and awareness of evaluating processes. (RH)

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HOW AND WHY DO WE CHANGE OUR PLANS?

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Over the course of studying planning behavior in young children and their plans as examples of their representational thinking, my colleagues and I have come to regard 5 levels or components as critical to the process. Levels may or may not be the correct term, so I generally refer to the various separate components, but since they do build upon one another for various functional purposes, some like to consider them as levels of planning.

Our analysis broke planning into 5 kinds of activities: the activities of defining and setting the bounds on a task; analyzing the requirements and/ or components that comprise the task; establishing a performance protocol if one were to execute the plan (optional, since plans are not always enacted); setting the standards or criteria for determining when the plan has been achieved or approximated; and evaluating the quality of the results of what one set out to do. We consider these activities the essential features of what constitute the higher-order cognitive skill of planning.

Others, namely Alan Schoenfeld, make certain points in discussing planning behavior that they regard as the essential ingredients, as well. Briefly, he and others discuss where plans change and the conditions of change; the internal and external components of planning, where plan formulation is considered as an internal process and communication of the plan as constituting a social or external process; the roles of reflectivity for the internal process and articulation for externalization of the plan; the coordination of knowledge structures that serve a problem-solving purpose of the planning function; and how initial expectations influence later plans and plan changes.

I'd like to begin by categorizing the cognitive issues of planning as dealing with the broader domain of mental representation and representational thinking. Those of us working in the area of mental representation are always confronted with 2 sides of an issue---the mental representation and what it means to the individual; and how the processes and mechanisms work in forming and utilizing the representation. The bigger issue, for me at least, is figuring out how the representation processes and mechanisms function---specifically the mechanisms that govern the 4th and 5th levels of planning I mentioned. Namely, the development and functioning of the evaluation and appraisal processes of knowing when you've achieved your planning objectives are at the heart of the work I report. I think these behaviors exemplify a completely different

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kind of cognitive control.

The issues that emerge from analyses of gaining expertise in planning are also representational issues, but they are more of the first type I mentioned in that the focus is upon expertise and proficiency---a skills focus in which discovery, a knowledge base, and the development of strategies are at the heart of the matter. This kind of model builds upon development of a knowledge base, developing strategies, and gaining control over those strategies in a variety of situations.

Strategies, in this sense, means "Plans" and consequently strategy selection means the plan itself or a modification of the plan. Metacognition comes in as a control factor, allowing the problem-solver to plan the approach, measure success or progress, and to attempt alternatives.

The planning that is taught in schools and implied in novice-expert shift models is a strategy development and protocol analysis approach. One learns to define the task, to analyze the task, figure out what to do or to learn in order to carry out the task, figure out how the task should be performed differently under different circumstances in different surroundings and under different conditions, etc. This is the problem-solving approach, driven by external or task demands. The goal, generally, is to get learners to be explicit about what a task requires (definition and protocol), and to look for more efficient ways (strategies) for performing the task. The focus upon getting things done in less time, searching for a better more efficient sequence, etc. are all implicit in the task-driven problem-solving study of planning.

The shift to reflecting upon the plan's quality and the metacognitive processes that promote this kind of thinking are a shift to internal criteria and decision-making. And it's this shift to learning and developing standards---personal standards---that I would like to focus on. It is the shift to the metacognitive skills that enable one to monitor behavior and thoughts about behavior. The evaluation process and the process of developing evaluation criteria, specifically, are the focus here.

The reason I am putting such importance upon these metacognitive aspects are simple. First, I think this emphasis takes planning efforts to a point of considering quality of performance ---not just proficiency or efficiency. I believe that quality of behavior is an under-represented area in competency models of cognition. Proficiency -- getting the sequence straight, speed, etc. drive most planning research, or at least are the primary dependent variables in measuring the development of planning skills. Second, we tend to regard evaluation processes and quality standards to be adult- or later-development indices of cognitive development. Quality of performance is not conceptualized in developmental models to

include early cognition.

What follows is a line of argumentation to illustrate metacognitive processes and planning as closely-related behaviors, and then, that planning and evaluation are collateral behaviors even in very young children. The metacognitive links, I believe, are at the level of developing standards for reflecting on the plan and evaluating the quality of planning efforts. These two steps or levels (4 & 5) in the planning analysis that I outlined in the introduction, shift from the performance-based criteria of planning (levels 1-3) to the monitoring functions of planful behavior.

Metacognitive development would appear to be closely related to the development of planning skills. Both metacognition and planning involve representation; both imply a degree of reflectiveness and distance from the immediate actions. The metacognition involved in knowing what one does and does not know how to do, for instance, is relevant to planning how to approach or carry out a given task. Even judging the difficulty of a task and how much planning it requires is a metacognitive activity. To get a clearer understanding of children as planners, I am suggesting, we need to find out what kinds of metacognitive activities they are engaging in.

In my research, I use language as the dependent variable for metacognition, and unstructured representational tasks, such as art or play, as the situations or contexts of the metacognitive and planning verbalizations. The examples that follow in this discussion are from children between the ages of 3 1/2 and 5 who were tape recorded as they were in play and art activities. The play set-up, in what follows first, was contrived so that certain props and objects were required to carry out the play activities--envelopes for letters, pitchers for Kool-Aid, shoes and shoe laces. None of the props were real objects or toy representations of real objects, however. Objects which suggested qualities of the necessary items were embodied in the various objects that were available in the play setting--such as a flat, small piece of pegboard and a string in it which suggested the shoe lace aspect of a shoe. The important point is that there was a variety of objects to choose from but none of the objects matched the real objects called for in the play scenarios on all of the traditional attributes. Children had to make some decisions about features of the options they could choose. It was the children's verbalizations as they engaged in these activities of choosing and decision-making that provided the wealth of information about the level and nature of their representational awareness---specifically their metacognition and reflectiveness in finding representations for real objects.

We found that children freely commented on the objects and their object choices; we didn't have to elicit commentary from them. They spoke of the appropriateness of objects for the intended use, of problems with the objects as substitutes, of the

lack of satisfactory choices, and of the difficulty in making up their minds. Such commentary, as a whole, reflects the fact that choosing objects for use even in pretending is not an automatic process. Instead, selecting props for play is a reflective process in which the play participant maintains a self-awareness regarding his or her symbolic play activity.

The types of things children say when selecting objects reflect the nature of the cognitive activity underlying their choices. The following few examples illustrate the emergence of evaluating processes that we identified in our research. These examples are from the play episodes mentioned previously.

One class of commentary involved VERBALIZING SATISFACTION WITH OBJECTS.

This category for including the object into the play scenario appeared in one of two forms:

- 1) WITHOUT COMMENTING ON WHY THE OBJECT WAS SUITABLE
(e.g., "Ah, there's an envelope!")
or,
- 2) SPECIFYING WHY THE OBJECT IS SUITABLE
(e.g., "I think this is a shoe. You know why?
(demonstrates that it can be worn). That's why")

A second class of appraisal commentary involved VERBALIZING WHAT WAS WRONG WITH THE OBJECTS THAT WERE NOT CHOSEN FOR PLAY.

These objects were always excluded from the play scenarios; the relevant characteristics were not assimilated into the plan of action, and the children did not accommodate their behaviors toward the objects.

Again, two forms of this category were in evidence:

- 1) REJECTING AN OBJECT WITHOUT COMMENTING ON WHAT'S WRONG
(e.g., "There's no shoe.")
- 2) REJECTING ALL OBJECTS WITH SPECIFIC STATEMENTS ABOUT WHAT'S WRONG WITH THEM
(e.g., [Looking for a pitcher for pouring] "This one doesn't have a handle (pointing to the spout on the other pitcher & being confused about the word). Needs to have a handle.")

A third category involved VERBALIZING DISSATISFACTION WITH OBJECTS CHOSEN FOR PLAY.

These objects were incorporated into the play, the fact that they were regarded as less than perfect. That is, the assimilated the available resources and accommodated their behaviors accordingly.

Two types of accommodated (dissatisfied) choice verbalizations were:

1) COMMENTING ON WHAT'S WRONG

(e.g., "This would be better with a handle [referring to pitcher with spout, selected for pouring water].")

2) COMMENTARY, ACCOMPANIED BY MODIFYING THE OBJECT.

(e.g., "This one [milk carton 'shoe'] doesn't have one [shoe lace]. Poke a hole in it and we could take this [lace from peg board 'shoe']. Get this for a shoelace.")

(e.g., "H-m-m-m, you have to put that together somehow ...I'm pretending something's right here.")

And finally, we saw two related categories, both of them involving PONDERING CHOICES VERBALLY.

1) VERBALIZING THAT MORE THAN ONE OBJECT HAS APPEAL

(e.g., "Let's see, which pitcher should I take?"
I can't find the goodest one.")

2) TALKS WHILE CHOOSING--THINKING ALOUD

(e.g., "Look in there and see what would be good for a shoe [looking in a drawer]. Good for a shoe..good for a shoe. Is this? [puts shoe on foot]. It probably will.")

Comments of the types described are of considerable interest. First, it is clear from these spontaneous, unelicited remarks that the children have standards about what constitutes a suitable substitute object in a given play situation, and it demonstrates that the children make their choices after considerable thought.

Second, the children's comments include thoughts about why a given object is a good choice, why a rejected object is not desirable, and what is less than ideal about a chosen object though it might be the best available. Sometimes children talked about how difficult it was to decide between one object and another or expressed their dissatisfaction with all the available choices. On occasion we heard them ask themselves aloud whether or not a given object would do. In some of these remarks the children showed an awareness of their own evaluating processes or of the representational task. These are particularly interesting as evidence of metacognition. But to the point of the present discussion, standards of evaluation, comparisons among skills and products, statements of planning all reflect various aspects of planned, organized thinking.

Some of the children showed a tendency to use verbalization as a bridge for the gap between the object as it was and as it should be for the play scene. They knew if the item met the specifications or if they could supplement, verbally or gesturally, for any shortcomings. This is a kind of monitoring by children, in that they are checking against some standard at various junctures during the activity---a sort of planning-in-action. In these instances, we have found that children are not automatically satisfied with what's available for their play choices. Alongside their imaginative abilities, the children manifest their active use of standards or criteria of representation.

Checking the product to determine if they've been successful is a different type of monitoring we saw used by children. Whereas the former type of checking along the way involves monitoring and editing, this latter is evaluative for judging if you've been successful in what you intended to achieve. I am suggesting that this is a separate level of the planning process (level 5 in the introductory scheme). It's qualitatively different from defining the task, analyzing the task, or coming up with a set of activities for carrying out the task.

Metacognitive questions have not been investigated much so far, partly because most research in the past has generally been focussed on what the children do rather than what they think or say about their efforts. I am suggesting that research which has focussed on the efficiency of plans, the proper or maximally useful sequences in the steps of a plan, etc. have diverted attention away from the thinking behind planning and the planning process. By examining verbal data that accompany the processes we can see not only how the children actually deal with these problems but also what they think about them. We get clues about the extent to which children are reflective in their approach to the solving of various organizational problems and in planning their productions. In children's verbalizations we find a reflection of their awareness of their own problem-solving processes in the representational realm.

The major limitation of verbal data, however, is that they do not convey "levels" of the planning process. Verbal data give substantiation of planning, but they aren't very useful for telling us how much in advance (number of steps) or how long a time frame ahead the child plans. The verbal comments reflect steps and sequences in planning and reflective assessments, and through such comments we get an idea of what the child understands and how she is monitoring ongoing mental activities.

In dissecting statements which reflect the planning children put into their work, one needs to consider that many different and levels of planning may be in evidence. Planning may involve statements in intention, statements of identifying what he or she will do, how he or she will proceed, the sequence or sequences that may follow, after-the-the-fact reflection on what has been

done and what needs to follow, and it can be commentary on progress or completion. These all reflect different kinds of knowing about what one intends to do, how one intends to accomplish a goal, and knowing when one has achieved what was intended.

SUMMARY

HOW PLANS CHANGE

The verbal data indicate an increasing awareness of evaluating alternatives and the adequacy of alternatives: Recognizing what's adequate or not perfect about an alternative, to specifying the qualities that make something a preferred choice or a poor substitute. Combinatorial thinking comes into play as children try to pick and choose isolated features from several alternatives and come up with their own composites. Three-and-a-half year-olds through 5 year-olds were manifesting these performance and selection criteria. So, how plans change--HOW as a mechanism -- is through reflective thinking and how plans change -- HOW as outcome -- is in terms of qualitative features that coincide with the planners' conceptualizations based on his/her conceptual development. The obvious predictions, therefore, are in the linkages between planning behaviors and categorical & conceptual thinking.

WHY PLANS CHANGE

This aspect of the question can be addressed as a set of external demands: the obvious situational constraints or needs change or the plan didn't work, so you change it. In the performance or functional analysis, the terms or definition of the need changes, or you decide that the protocol is no longer the most appropriate or interesting, so you change your strategy. Some interesting work came out of Sylvia Scribner's group a few years ago on how cognitive behavior changes in order to keep routine tasks interesting, in this case, how bartenders learn to make their jobs more interesting. The research looked into how bartenders learn to make the wide variety of drinks they need to know. The results confirmed, essentially, the cognitive efficiency of good, categorical thinking. Rum drinks, gin drinks, vodka drinks, etc. are learned by the essential, defining attribute--the major ingredient. They are reclassified according to the type of drink--a sour, a sling, etc., where the ingredient becomes secondary. Thus, a rum sour, a whiskey sour, and other sours are classified into the same group, whereas they were in separate categories when classified by liquor group. Multiple classifications continued with other mixes (tonic, club soda, etc), and so forth. The point is that bartenders were constantly changing their schemes/ or memory strategies once they had become proficient in their craft. Why did they change? For variety, and their self reports indicated that there was another reason: they continued to re-evaluate drinks for unusual cross-

over attributes to streamline memory strategies and to keep their job interesting. The point is, self-motivated monitoring makes thinking more interesting and changes thought qualitatively.

What appears to be happening beyond proficiency or efficiency is representational thinking about how the activity is represented. Why plans change, then, can be an extension of the implicit demands of the task or an extension of goals for efficiency to activities that make life more interesting. The 2 levels of planning that emerge from this kind of cognition, I think, are dealing with figuring out relevant and changing criteria of the task. This involves developing evaluation criteria and secondly, thinking about final outcomes and then measuring those outcomes against some standards to determine if you've achieved what you set out to do. Both of these aspects of planning involve self-monitoring and are the nexus of planning and metacognitive skills.

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